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THE HOUSE FLY AS A DISEASE CARRIER AND HOW CONTROLLED

By W. E. BRITTON, PH.D., *State Entomologist*

The common house fly* has been associated with epidemics of typhoid fever so frequently during the last few years that Dr. L. O. Howard suggests that it be called the typhoid fly. Flies carry disease germs mechanically by breeding in filth and crawling over it, and then crawling over food in kitchen and pantry. If the filth contains the causative germs of human diseases, these diseases are thus liable to be transferred to food, and persons eating it are endangered. Not only are the germs carried on the feet, tongue and hairs of the house fly, but they are taken into its digestive tract and are voided with its excrement, thus making fly specks positively dangerous.

The house fly is worse than other kinds of flies because it is more abundant and because of its habit of visiting human food.

A number of diseases are carried in this manner, the principal ones being intestinal diseases of an infectious nature, such as typhoid fever, cholera, and dysentery. Typhoid especially is liable to be spread by flies, as the bacterial germs are voided with the feces and urine of the patient often before the disease is recognized, and sometimes long after the patient has apparently recovered. There are occasional cases of walking typhoid, and if one of these enters a community where flies are abundant, an epidemic may follow. Especially great is the danger in summer camps, construction camps, shore resorts, and country villages where sanitary improvements are lacking. The excreta from typhoid patients should never be exposed to flies, for if visited by flies, the disease is not only liable, but is almost certain to be spread.

* *Musca domestica* Linn.

In this manner flies were found to be chiefly responsible for the spread of typhoid fever in the United States military concentration camps during the Spanish War, especially at Chickamauga. The sinks were allowed to overflow, and flies were not only attracted by the filth but bred in it. The mess tent was close by, and flies swarmed over the food. During the investigation, flies were collected upon the food with their legs whitened by the lime thrown upon the filth of the sinks. In the South African War, similar conditions occurred in the camps in South Africa and in Ceylon.

In the Chicago typhoid epidemic of 1902, and in an outbreak of this disease on the Minnesota Iron Range in 1910, flies were found to be the chief agents in the spread of the disease.

Typhoid fever was formerly very prevalent in Bermuda, and caused many deaths, but in 1904 Major Wanhill was placed in command, and in two years nearly eradicated the disease through his warfare against the house fly, which he found the most important agent in its transmission.

The outbreak of cholera in North China in 1902 was spread largely by flies, which were exceedingly abundant there, and the cholera germ was isolated from them.

An epidemic of bacillary dysentery at Springside Home, New Haven, in 1901, is believed to have been spread by flies, and in 1910 there occurred a similar outbreak at the Worcester, Mass., State Hospital, the spread of which was attributed to flies.

Flies may also transmit certain other diseases such as tuberculosis and diphtheria by visiting sputum, and there is evidence to show that anthrax, trachoma, septicaemia and leprosy may be carried by flies.

LIFE HISTORY AND HABITS.

The female house fly may lay 150 eggs (see figure 2), though 120 is the average, one-half of which produce males. In about eight hours the eggs hatch, and the white maggots (see figure 3) live five days, when they become fully grown and transform to the pupa stage (see figure 4), which also requires

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1. A filthy yard. Breeding place of house flies. 2. Mass of eggs laid in horse manure, natural size. 3. Maggots of house fly, three times enlarged. 4. Pupae of house fly, three times enlarged. 5. Adult house fly, five times enlarged.

a period of five days before the adult fly comes forth. Thus only about ten days are required in warm weather for the fly to go through the entire development from the egg to the adult stage, which is shown in figure 5. In cool weather the development is retarded, and a longer period is required. As there are probably from seven to ten generations annually in Connecticut, allowing half of each to be males, the possible progeny from an over-wintering female in seven generations amounts to over 5,500,000,000,000 in a single season. As a matter of fact, a large proportion are killed before maturity, so that the actual number is much smaller. Nevertheless, these figures show the possibilities, and explain why house flies increase so rapidly in a given locality during the warm months of summer.

Flies generally pass the winter as adults, in the cellars and garrets of heated buildings, and no doubt they also exist in a dormant condition in many cold but protected situations. During the summer months flies live only a few days after reproducing. The October generation lives through the winter, though without laying eggs, and probably without even mating.

Not only are flies attracted by food, but nearly all kinds of liquids attract flies. Milk, soda water, and sweetened drinks, and especially confections, are attractive to flies. If candies and foods are exposed, they will soon become covered with fly specks.

Filth of all kinds, including manure, swill tubs and garbage cans, all sorts of decaying animal and vegetable matter, dead animals, sores and wounds of living animals and human beings, also attract flies quite as much as food and drinks. Especially are flies attracted by odors from the kitchen, where meats and vegetables are cooking.

Though flies are strong fliers, and are able to go far, as a rule they fly only short distances, especially if attractive food supplies and breeding places are at hand.

BREEDING PLACES.

House flies breed in all kinds of manure, especially fresh horse manure and cow dung. It was formerly supposed that they bred only in horse manure, but it has recently been shown that they breed to some extent in human excrement, in hog and chicken manure, spent hops and malt sprouts used as a fertilizer, in garbage cans, compost heaps, and even between the folds of old paper and old rags in the ashes on the dump. The maggots are seldom found more than two or three inches below the outer surface of the heap. When mature the larvæ go downward into the manure in the lower edges of the heap or into the soil around the outside of the heap and transform to puparia.

The most common breeding place, no doubt, is the manure which is allowed to accumulate in and around stables in summer; but in any attempt to reduce the number of flies all other possible breeding places should receive attention.

COMMON PRACTICES WHICH ARE NOT SANITARY.

Stable manure is often allowed to accumulate, unscreened and untreated, in the barn or stable, even though this is located near the house. Flies are sure to breed in such places in warm weather, and are attracted to the doors and windows of the kitchen and pantry by the odors of the food being cooked and stored there. They are ready to dodge in whenever the screen is opened, and are a constant source of annoyance to the housekeeper who tries to "shoo" them out. They crawl over the food, and soil the windows, fixtures and furnishings of the room.

Manure, unless treated, or protected from flies, should not be allowed to accumulate near any house. Too often on the farm a swill tub is wholly exposed to flies, which are attracted by the fermenting and decaying substances in it, and fairly swarm around it. The privy, also, is seldom screened, and flies visit it and breed therein.

The conditions named above are common not only on farms and in country villages, but also around the outskirts and in certain sections of many large cities. The daily visits of milk carts, fish and meat carts and bakers' wagons, going from house to house and followed in each case by a swarm of flies, ensures a distribution of the insects, as a few remain at each stopping place, and others join the nomadic group. If disease-bearing flies exist at any of these stopping places, they are apt to be distributed along the route, and the disease may thus be spread. Lumber camps, construction camps, and summer camps at the shore or in the mountains are particular points of danger, because on account of their temporary nature sanitary improvements are lacking, and the gathering of people from different parts of the country introduces an additional element of danger which might not exist if all came from the same locality. Then, too, the laborers in lumber camps and on construction work are not posted in sanitary matters, and are apt to be careless in the disposal of refuse. The owners and managers, unfortunately, are seldom considerate of these matters, but are probably more anxious about the execution of their contracts and the obtaining of their profits than about the health of their men. In such cases the local health officer should assume and maintain strict supervision of the sanitation of the camps.

Carloads of stable manure from the large cities are drawn through towns, villages and cities, and often allowed to stand for several days on the sidings. These are prolific breeding places of flies in warm weather.

BANISH FLIES FROM THE SICK ROOM.

Under no conditions should flies be permitted in the sick room. They disturb the patient while he sleeps, and annoy him when he wakes. They crawl over his food and sip from his drink. To say the least, it is certain that they have just come from the stable, the swill tub, or the privy, and the reflection on their close association with filth, and their part as disease carriers, will not aid the patient on the road to recovery. More-

over, if he has a contagious disease, they may infect other households; or they may bring contagion to him. In case of typhoid fever or cholera, the danger is great.

In such diseases as scarlet fever and smallpox, or in fact any other infectious or contagious disease, especially in warm weather, the quarantine should be rigidly enforced against flies, for the safety of the community.

HOW TO GET RID OF FLIES.

The fly pest may be controlled or eliminated altogether in any locality by the practice of a few simple methods which are not expensive. The result will prove a great benefit to the health of the community.

Removing Manure:— Unless protected from flies, manure should not be allowed to accumulate near human habitations. It may be carted away to distant fields once each week. This is probably the best method on the average farm or country place, and the manure may be either spread directly upon the land, or stored in heaps far enough away from houses so that flies will not be troublesome.

Screening Manure:— If inconvenient to remove the manure each week, it may be kept in a dark pit, or in a box, bin or shed which has been rendered fly-tight by careful screening. Many cities now have ordinances requiring one of these two methods of handling manure between May 1st and November 1st of each year.

Treating Manure:— It has long been known that chloride of lime and certain other chemicals, when applied to manure, will prevent flies from breeding in it, but most of these are objectionable because they injure the manure as a fertilizer. Most forms of lime and many other alkali salts, when applied to the manure, will set free the nitrogen which goes off into the air in the form of ammonia.

In recent experiments conducted by the Bureau of Entomology of the United States Department of Agriculture, Washington, D. C., it was found that two common and well-

known materials, — borax and hellebore — are effective in destroying the eggs and maggots without seriously injuring the manure for fertilizer uses.

Borax:— Commercial borax* used at the rate of .62 (about two-thirds) pound per 8 bushels (10 cubic feet) of manure, applied by sifting the dry powder upon the manure, especially around the shallow edges of the heap near the floor or ground, will kill the eggs and larvæ therein. It is in the fresh manure that the eggs are laid, and as fresh manure is added to the heap each day additional borax should be applied. The manure can be measured and the required quantity of borax, if weighed once or twice, can be measured afterward with sufficient exactness for all practical purposes. The cost is less than one-half a cent per bushel, and less than one cent per day per horse.

This treatment is more effective if well saturated with water from a hose immediately afterward. Though this treatment will not injure the manure as a fertilizer for farm crops, it yet remains to be seen whether manure so treated is entirely safe for the purposes of the florist and truck gardener, who use manure in much greater proportions in the soil than the farmer. One florist has already complained of injury to plants from borax-treated manure.*

Hellebore:— Further tests by the Bureau of Entomology** show that powdered hellebore mixed with water at the rate of $\frac{1}{2}$ lb. in 10 gallons for each 8 bushels, allowed to stand several hours, and sprinkled upon the manure on removal from the barn, is just about as effective as the borax treatment, with no harmful results. The cost of this treatment is about 0.7 of a cent per bushel or less than $1\frac{1}{2}$ cents per horse each day. American hellebore is the dried and powdered root of *Veratrum viride*, a plant fairly common in the swamps and low lands of Connecticut. It is used extensively to kill the currant worm and may be procured from any druggist or dealer in

* Bulletin No. 118, U. S. Department of Agriculture.

* Florists' Exchange, Vol. XLI, page 546.

** Bulletin No. 245, U. S. Department of Agriculture.

insecticides. Hellebore apparently does not injure the manure from any standpoint.

Trapping the Maggots:—As the maggots tend to go downward before pupating, they can be destroyed by building a maggot trap under or around the margins of the manure heap. This idea has also been developed by the Bureau of Entomology.* The trap may consist of a shallow concrete basin or cistern containing water. Maggots drop into the water and are drowned. Where such a trap was in experimental use, apparently about 98 per cent. of the maggots were destroyed. The chief disadvantage of such a system is that the basin will become a breeding place for mosquitoes unless screened or the surface kept well oiled.

Give Attention to Other Breeding Places:—Having cared for the accumulations from the stable, attention must be given to the privy, the hog pen, the chicken house, the swill tub and the garbage can. First, wherever feasible, the dry closet should be abolished and a water closet installed, with sanitary connections with a sewer or cesspool, properly ventilated. If this is not feasible on account of an inadequate water supply or on account of expense, a very satisfactory wet closet may be constructed from an oil barrel at a small cost, after instructions given in Public Health Report No. 54. If the water in the tank be kept covered with a film of oil, there will be no trouble from insects. The old dry closet usually is not well cared for and may be very dangerous in cases of intestinal diseases. It would be interesting, and no doubt appalling, to learn how many lives have been lost through its use. The dry closet is much safer, however, if it is screened securely from flies, and the waste matter kept well covered with dry loam or coal ashes, and treated two or three times a week with borax or chloride of lime.

The chicken house, hog pen, swill tub and garbage can should be some distance from the kitchen. Where not feasible to screen these, the use of fly traps around them, especially early in the summer, will do much to control the fly nuisance.

* Bulletin No. 200, U. S. Department of Agriculture.

Use Fly Traps:— By the use of traps out of doors around the stable, the swill tub, the garbage can, and especially near the back door of the kitchen, placing the traps early in the season to catch the over-wintering flies, much will have been accomplished in abating the fly nuisance. If this measure could be carried out generally it would make a great difference.

A modified form of the balloon fly trap has been devised by Professor C. F. Hodge formerly of Clark University, Worcester, Mass., and sold by most dealers, which may be suspended, placed on the cover of the garbage can, hung on the fence, or placed on the screen of the door or window. This trap may be used either in the house or out of doors, and may be baited with something that will attract flies.

Fly Poisons:— There are a number of fly poisons on the market, and some of them contain arsenic. They are all more objectionable than traps, because the dead flies are dropping anywhere and everywhere, perhaps into the food. One of the best fly poisons is formalin mixed with water in about five per cent. strength, exposed in a shallow dish. The flies will drink it and die. Professor R. I. Smith of the North Carolina Experiment Station recommends one tablespoonful of commercial formalin to a half-pint cup of half milk and half water, placed on a shallow plate, with a slice of bread in the liquid. The bread gives more surface upon which the flies may alight. Formalin fly poison is not dangerous to use, and is especially successful in reducing an abundance of flies if the room can be closed, and if they do not have access to any other form of moisture.

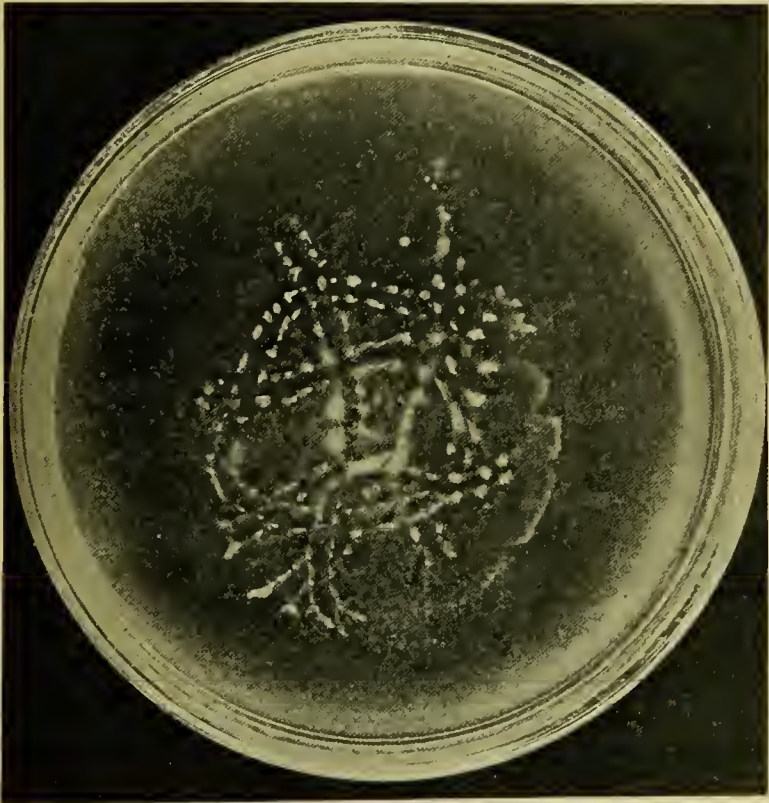
A liberal use of fresh insect powder (Pyrethrum) in a tightly closed room at night will stupefy the flies, which may be swept up in the morning and burned.

Fly Paper and Fly Killers:— Sticky preparations like Tanglefoot fly paper will kill many flies, but are in themselves more or less of a nuisance in the house, and other things are liable to get stuck in them.



It is always well to have a wire fly killer to destroy the stragglers that dodge the traps and avoid the poison and other devices for their destruction.

Screen Houses, Restaurants and Stores:— All inhabited houses should be provided with screens and all foodstuffs in stores, restaurants and private houses, should be kept out of the reach of flies. Purchase food only at clean places. It is especially important that *flies be kept away from food and from human excrement.*



Colonies of bacteria growing on a sterilized culture plate, inoculated by a fly crawling over the surface. Every colony or white spot consists of millions of germs, some of which may be disease producing germs. The fly leaves just as many bacteria when crawling over food.

SUMMARY

The house fly, on account of its habit of breeding in filth and visiting filth, and then crawling over food, is a carrier of the germs of human diseases, especially typhoid fever, cholera and dysentery. Many epidemics have been traced to the agency of flies.

The female fly lays about 120 eggs, the maggot and the pupa each live about five days, making about ten days from the egg to the adult stage. The winter is probably passed as an adult. From seven to ten generations occur in Connecticut each year.

Flies breed in stable manure, privies, brewery waste, garbage, or in almost any decaying animal or vegetable matter that is sufficiently moist.

Insanitary practices on farms and in villages and cities are chiefly responsible for the numbers of flies, and these endanger many lives through the spread of disease. Temporary camps are danger points.

Flies should never be tolerated in a sick room, and should be kept away from food and from human excrement. The fly nuisance may be abated and controlled by abolishing the breeding places, treating the manure heaps with hellebore or borax, trapping the maggots, using fly traps and fly poisons, and screening houses, stores and restaurants.

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